Journal of Agriculture and Food Sciences
Volume 17 Number 1, April 2019 pp 79 - 88

QUALITY EVALUATION OF OILS EXTRACTED FROM SOME SELECTED INDIGENOUS SPICES

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ABSTRACT

A food grade solvent (n-hexane) was used in the extraction of oil from some selected indigenous spices which were ehuru (Monodora myristica), njangsa (Ricinodendron heudelotii), uziza seeds (Piper guineense) and cloves (Syzygium aromaticum). The extracted oil samples were evaluated for chemical composition and physical properties. Results obtained from the chemical composition of the extracted oil samples showed that acid value, iodine value, peroxide value, saponification value and thiobarbituric acid value ranged from 0.64mgKOH/g to1.82mgKOH/g, 63.17gmI/100gm to 83.33gmI/100gm, 5.78Meq/kgto9.66Meq/kg, 142.07mgKOH/g to 203.66mgKOH and 0.19mg malo./kg to 0.39mg malo./kg respectively. The results of the physical properties of the extracted oil samples also showed that the smoke point, flash point, firepoint, density, melting point and viscosityranged from 166°C to 214°C, 206°C to 254°C, 219.50°C to 275°C, 0.89g/cm³ to 0.94g/cm³, 12°C to 17°C and 58.40cp to104.10cp respectively. From the study carried out, it was concluded that the oils extracted from the selected indigenous spices are acceptable for efficient use in food production and other industrial uses.

Key words: Indigenous spices, chemical properties, physical properties, oil extract

https://dx.doi.org/10.4314/jafs.v17i1.6

INTRODUCTION

A spice is a seed, fruit, root, bark, or other plant substance primarily used for flavouring, colouring, or preserving food. Spices are distinguished from herbs, which are the leaves, flowers, or stems from plants used for flavoring or as a garnish, sometimes spices may be ground into a powder for convenience. Many spices have antimicrobial properties. This may explain why spices are more commonly used in warmer climates, which have more infectious diseases, and why the use of spices is prominent in meat, which is particularly susceptible to spoilage (Thomas *et al.*, 2012).

Spices are the building blocks of flavour in food applications. The word “spice” came from the Latin word“species”, meaning specific kind (Tajuddins et al., 2003). The name reflected the fact that all plant parts have been cultivated for theiraromatic, fragrant, pungent or any other desirable properties including the seed (aniseed, caraway, coriander),kernel (nutmeg), aril (mace), leaf (cilantro, kari, bay, mint), berry (all spice, juniper, black pepper), stem (chives),stalk (lemon grass), rhizome (ginger, turmeric), bulb (garlic, onion), fruit (star anise, cardamom, chile pepper),flower (saffron) and flower bud (clove) (Chirathawornet al., 2007).

A spice may be available in several forms: fresh, whole dried, or pre-ground dried. Generally, spices are dried. A whole dried spice has the longest shelf life, so it can be purchased and stored in larger amounts, making it cheaper to be preserved. Spices tend to add few calories to food, even though many spices, especially those made from seeds, contain high portions of fat, protein and carbohydrate by weight. Many spices, however, can contribute significant portions of micro-nutrients to the diet (Thomas *et al.,* 2012).Most spices have substantial antioxidant activity, owing primarily to phenolic compounds, especially flavonoids, which influences nutrition through many pathways, including affecting the absorption of other nutrients (Ninfali *et al*., 2005). Although, it is known that spices have some antimicrobial properties; also oils can be obtained from them, yet there is 'limited knowledge on the quality of oil extracted from some of these spices, especially the indigenous spices. This study therefore was aimed at extracting oilfrom selected indigenous spices and evaluating the physical and chemical properties.

MATERIALS AND METHODS

Sample procurement and preparation

The African nutmeg or ehuru (*Monodora myristica*), clove (*Syzygium aromaticum*), njangsa (*Ricinodendron heudelotii*) and uziza seeds (*Piper guineense*)were purchased from School Road Market and Relief Market, all in Owerri, Imo State.The chemicalsused for the oil extraction and analyses were obtained from the laboratory of Food Science and Technology Department, Imo State University, Owerri.

The extraction method used was a modification of those used by Akinside and Olukoya (1995) and Akinyemi *et al*. (2000).The selected spice samples were dried in the shade at room temperature and then grounded into powder.Oil was extracted from the grounded spices using solvent extraction method. Oil extract from each spice was obtained by dissolving 30g of dry grounded spice in 300ml of food grade solvent (Normal hexane) and allowed to stand for 48hr at room temperature. The extracts were concentrated using a rotary evaporator under vacuum at 35° C.The extracted oil from each spice sample was stored in an air tight container for laboratory analysis.

ANALYSES

Physical and Chemical Analyses

The extracted oil was immediately analyzed for physical properties such as smoke point, flash point,density, melting point and viscositywhile acidvalue, iodine value, peroxide value, saponification value and thiobarbituric acid number were evaluated as the chemical properties. Estimation of the smoke point, flash point, density and melting point was done following the method described byOnwuka (2005) while viscosity was determinedaccording to the method described by Omode*et al*.(1995). Resultswere expressed as the means of two separate determinations.Acidvalue, iodine value, peroxide value, saponification value and thiobarbituric acid number were done following the method described byOnwuka (2005). Resultswere expressed as the means of three separate determinations.

Statistical Analysis

Results obtained were computed as means and the analysis of variance (ANOVA) was carried out using Statistical Package for Social Science (SPSS) version 20.0 Inc.USA.

RESULTS AND DISCUSSION

Physical Properties

Table 1 shows the physical properties of the extracted oil samples.

Smoke point

The smoke point of the oils extracted from the selected spices which ranged from166^{0}Cto214°C correlated favourably with that of hemp seed oil (165°C), Canola oil (200°C), coconut oil (177°C), walnut oil (204°C) and sesame oil (210°C) as reported by Jennifer (2012).

The smoke point of each oil sample was observed to differ significantly ($p<0.05$) amongst each other. Oil sample extracted from njangsa (*Ricinodendron heudelotii*) with the highest (214°C) value implied that it was most suitable for high temperature cooking.It won't burn or smoke until it reaches 214°C while the oil sample extracted from ehuru (*Monodora myristica*) withthe lowest (166^{0}C) value implies that it was not suitable for high temperature cooking, but suitable for low temperature cooking or adding to dishes and salad dressings (Dandjouma *et al*., 2008).

Flash Point

The purpose of this test was to determine the temperature at which the oil was flammable. The lower the flash point temperature, the greater the risk. Therefore, oil extracted from ehuru (*Monodora myristica*), clove (*Syzygium aromaticum*), njangsa (*Ricinodendron heudelotii*) and uziza seeds (*Piper guineense*) recording flash points between the range of 206.50^{0}C to254^{0}C hadlow risks of flammability although values obtained were found to be lower than that of canola oil (326°C), coconut oil (295°C) and sunflower oil (319°C) as reported by Hannah and Parameswari(2010).

Fire Point

Similar to flash point, the fire point of the selected spices which ranged from 219.50°C to 275°C were found to be lower than the fire point of other oils, for instance; soybean oil (1166°C), sunflower oil (1166°C), Canola oil (1133°C) (Abayeh and Okuonghae, 1998).

The fire point of oil is the lowest temperature at which the vapour will continue to burn for at least 5 seconds after ignition by an open flame. Also the purpose of this test was to determine the temperature at which the oil wasflammable. The lower the fire point temperature, the greater the risk of flammability (Shanthi and Syed, 2017). Therefore, ehuru (*Monodora myristica*) which recorded the fire point of 219.50°C had higher risk of flammability, while njangsa (*Ricinodendron heudelotii*) which recorded the fire point of 275°C had lower risk of flammability.

Fire point values are used for controlling quality and flammability (Shanthi and Syed, 2017).

Density

The densities of the oilsextracted from the selected spices which ranged from (0.89g/cm^3)to(0.94g/cm^3) compared favourably with that of coconut oil (0.93g/cm^3), cotton seed oil (0.93g/cm^3), sunflower oil (0.92g/cm^3) as stated by Thomas(2002).

Compared to water, whose density is 1.00g/cm^3, cooking oil is less dense(Thomas,2002). Therefore, oils extracted from ehuru, njangsa, uziza seeds and cloves can be used as cooking oils.

Melting Point

The melting point of the selected spices which ranged from (12.00^{0}C)to(17.00^{0}C) was found to be higher than the melting point of sunflower oil (-11°C), corn oil (-11°C), peanut oil (-2°C), but lower than the melting point of coconut oil (24°C) as reported by Vaughn(2017).Fats with a very high melting point are not palatable, since they tend to stick to the plate, oils that are highly saturated such as coconut oil melts at a higher temperature, while unsaturated oils melt at lower temperatures (Thomas, 2002). From the study, njangsa (*Ricinodendron heudelotii*) having the highest (17^{0}C) melting point showed that it was more saturated, while oil from uziza seeds having the (12^{0}C) lowest melting temperature was seen as least saturated.

Viscosity Point

Viscosity is a measure of an oil resistance to flow. It decreases with increasing temperature and increases (thickens) with decreased temperature (Streeter *et al.*, 1998). The viscosity of the selected spices which ranged from (58.40cp)to(104.10cp) compared favourably with that of corn oil (65cp), and canola oil (57cp). In this study, ehuru(*Monodora myristica*) which had the highest (104.10cp) viscosity meant that it has the oil was most resistant to flowand higher cohesion.

Chemical Properties

Table 2 shows the chemical properties of the extracted oil samples.

Acid Value

The acid values of the oil samples differed significantly ($p<0.05$) amongsteach other. According to Ojwang *et al*.(2015), the acceptable limit for edible oil is<10mgKOH/g. Therefore, the oil samples analyzed which ranged from 0.64mgKOH/g to 1.82mgKOH/g were all edible. And this implies that the oil extracted from ehuru, njangsa, uziza seeds and cloves was likely to stay long without forming off flavours.

Iodine Value

Iodine value is the degree of unsaturation in oil(Rasoarahona*etal.*,2005). The value obtained which ranged from 63.17gml/100gm to 83.33gml/100gm was found to be lower than the iodine values reported by Ojwang *et al*.(2015) for the seeds of wild plant *Tylosema fassoglensis* (94.06gml/100g) but compared favourably with Mahua oil (58gml/100gm to 70gml/100gm) as reported by Prajapati *et al*. (2015). Lower iodine value indicates lower level of unsaturation in the oil. Rasoarahona*et al.* (2005) proposed that iodine value above 100gml/100gm makes the oil drying and below 100gml/100gm is non-drying. The iodine values of ehuru *(Monodora myristica)*, njangsa *(Ricinodendron heudelotii)*, uziza seeds (*Piper guineense)* and cloves *(Syzygium aromaticum)* were below 100, therefore they can be referred to as non-drying oils which made them suitable for soap making and useful in food product.

Peroxide Value

The extent to which the oil has undergone rancidity can be determined by the peroxide value (Ojwang *et al.*, 2015). The reported peroxide values obtained in this study was within the permitted peroxide level of not more than 10Meq/kg of oil (FAO/WHO, 2015). Oil extracted from ehuru, njangsa, uziza seeds and cloves therefore had lower degree of rancidity.

Saponification value

Thesaponificationvalueisameasureoftheaveragemolecularweight(orchainlength)ofallfattyacidpresent(Agbaire, 2012). The relatively high valuesobtained were indicative that the oil samples extracted from ehuru, njangsa, uziza seeds and cloves had potential for use in the food industry.

Thiobarbituric Acid value (TBA)

Thiobarbituric acid (TBA) test is used for detecting the development of oxidation rancidity (Yusuf*etal.*,2014).TBA test is an indicator of lipid peroxidation, meanwhile, peroxidation of oils lead to by-products that negatively affect the palatability and health benefits of the diets (Yusuf*etal.*,2014).The thiobarbituric acid values of the selected spices which ranged from0.19mgmalo./kgto0.39mgmalo./kg was observed to have no significant difference ($p>0.05$) amongst each other. The reported TBA values obtained in were within the acceptable limit of not more than 0.5mgmalo./kg of oil as recommended by Nuernberg *et al.* (2002). Therefore, the

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lower values obtained in oil extracted from ehuru, njangsa, uziza seeds and cloves substantiated the occurrence of the protective action of natural antioxidant in the oil against peroxidation.

CONCLUSION

The present study was undertaken to evaluate the chemical composition and physical properties of extracted oil samples from selected indigenous spices. The oil samples had the potential of being used for large scale production since oils and fats play an important role in the structure, aroma and stability of a wide variety of food products, as well as in their nutritional properties.

Also the iodine value of cloves (*syzygim aromaticum*) and the peroxide value of ehuru (*monodora myristica*) showed they had very low susceptibility to oxidation and had great shelf life; the saponification value of njangsa suggested that it could be used in soap making. The smoke point of Njangsa (*Ricinodendron heudelotii*) indicated that it can be used for high temperature cooking.Therefore, these plant oils obtained from these selected spices were beneficial, since they met the characteristics of edible oil.Since the aroma of the spices were entrapped in the oils extracted from them, it was highly recommended in cooking without extra addition of the spices.

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Table 1: Physical Properties of the Extracted Oil Samples

	Parameters					
Sample	Smoke Point (°C)	Flash Point (°C)	Fire Point (°C)	Density (g/cm^3)	Melting Point (°C)	Viscosity (cp)
A	166.00±2.82[c]	206.50±3.53[c]	219.50±0.70[d]	0.89±0.01[c]	14.10±0.42[b]	104.10±0.42[a]
B	214.00±2.82[a]	254.00±2.82[a]	275.00±2.82[a]	0.94±0.01[a]	17.00±1.41[a]	58.40±0.28[d]
C	175.00±4.24[c]	223.00±1.41[b]	239.00±1.41[c]	0.91±0.00[b]	12.00±1.41[c]	79.70±0.00[b]
D	190.00±0.00[b]	243.00±2.82[a]	261.50±3.53[b]	0.92±0.00[b]	15.00±1.41[b]	63.95±0.21[c]
LSD	10.02	12.25	9.48	0.02	1.80	2.14

Values are means ± SD. Values on the same column with different superscripts are significantly different.

Key

Sample A - Ehuru (*Monodora myristica*)

Sample B - Njangsa (*Ricinodendron heudelotii*)

Sample C - Uziza seeds (*Piper guineense*)

Sample D - Clove (*Syzygium aromaticum*)

Table 2: Chemical Composition of the Extracted Oil Samples

	Parameters				
Sample	Acid Value (mgKOH/g)	Iodine Value (gmI/100gm)	Peroxide Value (Meq/kg)	Saponification Value (mgKOH/g)	TBA (mg malo./kg)
A	1.82±0.03[a]	78.43±0.29[b]	6.62±0.24[bc]	162.26±0.24[c]	0.39±0.04[a]
B	0.64±0.00[c]	63.17±0.38[d]	9.66±0.53[a]	203.66±0.98[a]	0.19±0.02[b]
C	1.15±0.09[b]	76.40±0.00[c]	7.40±0.36[b]	176.45±0.00[b]	0.25±0.03[b]
D	0.75±0.04[c]	83.33±0.80[a]	5.78±0.00[c]	142.07±1.36[d]	0.31±0.02[ab]
LSD	0.20	1.25	0.88	2.13	0.10

Values are means ± SD. Values on the same column with different superscripts are significantly different.

Key

Sample A	-	Ehuru (*Monodora myristica*)
Sample B	-	Njangsa (*Ricinodendron heudelotii*)
Sample C	-	Uziza seeds (*Piper guineense*)
Sample D	-	Clove (*Syzygium aromaticum*)
TBA	-	Thiobabituric acid number